



21st century parking management

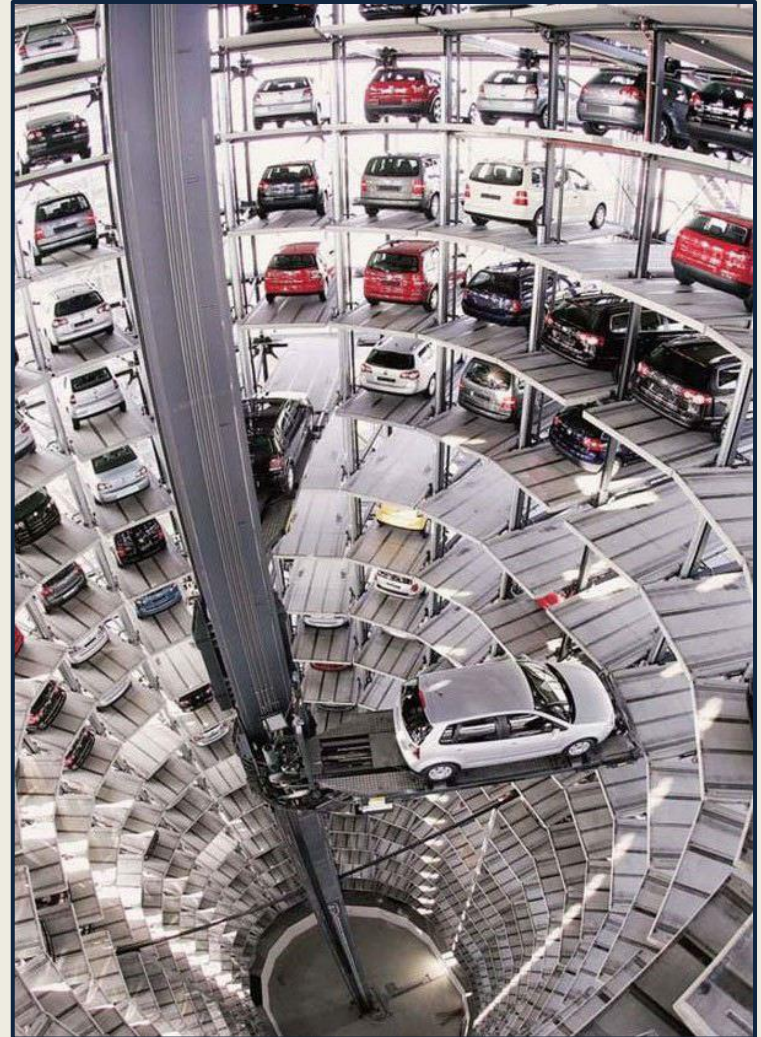


tonight

trends

challenges

parking management



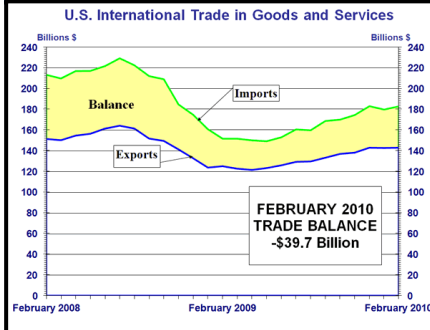


trends



culture

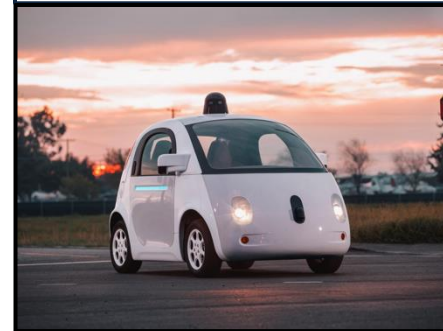
economics



energy prices



technology



vehicular travel



economics

*median earnings
age 18 - 34*

+ \$871

+ \$639

2013

\$33,883

1980

\$35,845

1990

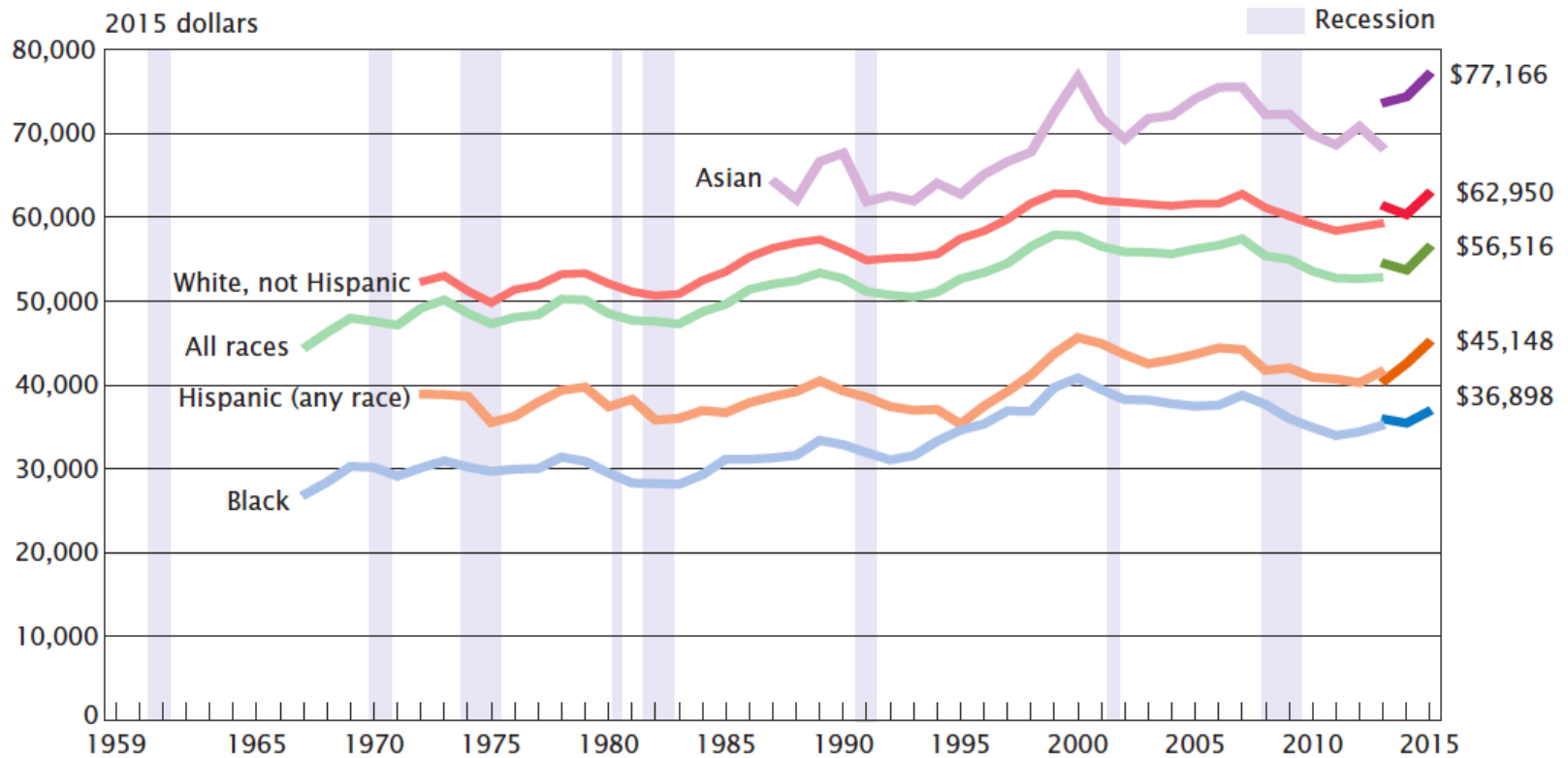
\$36,716

2000

\$37,335

- \$3,472

Figure 1.
Real Median Household Income by Race and Hispanic Origin: 1967 to 2015

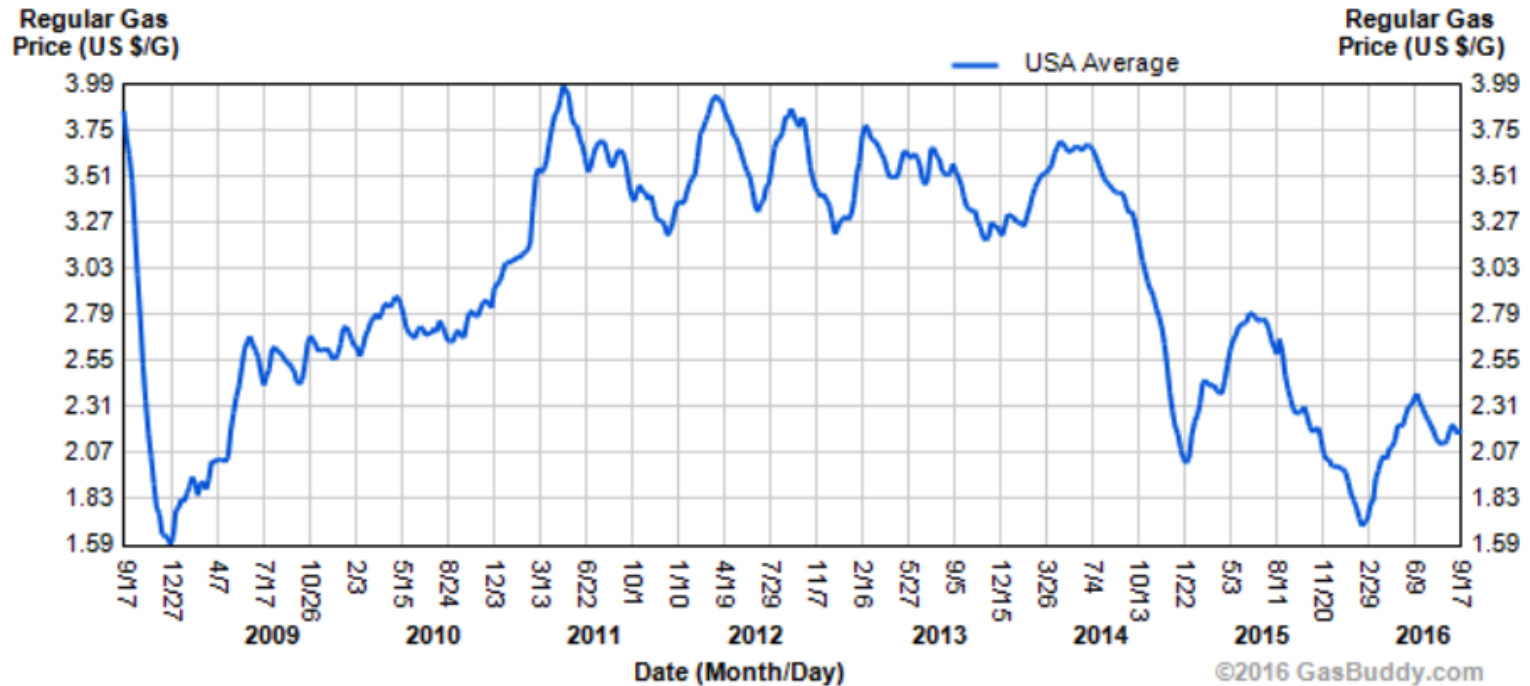


household income

Historical Price Charts

Quick charts: [1 Month](#) | [3 Month](#) | [6 Month](#) | [9 Month](#) | [1 Year](#) | [18 month](#) | [2 Years](#) | [3 Years](#) | [4 Years](#) | [5 Years](#) | [8 Years](#) | [9 Years](#) | [10 Years](#) | [11 Years](#)

96 Month Average Retail Price Chart



gas prices



photo credit: Google

autonomous vehicles

goodbye to drivers?

information/remote sensing technology

- ✓ radio sensing
- ✓ cameras
- ✓ radar
- ✓ LIDAR (laser)
- ✓ gps & cell phone sensing/mapping
- ✓ virtual transaction systems
- ✓ user interface design

established

emerging

- ✓ v2v and v2i communications

vehicle control/crash avoidance technology

- ✓ cruise control
- ✓ automatic braking system
- ✓ stability control

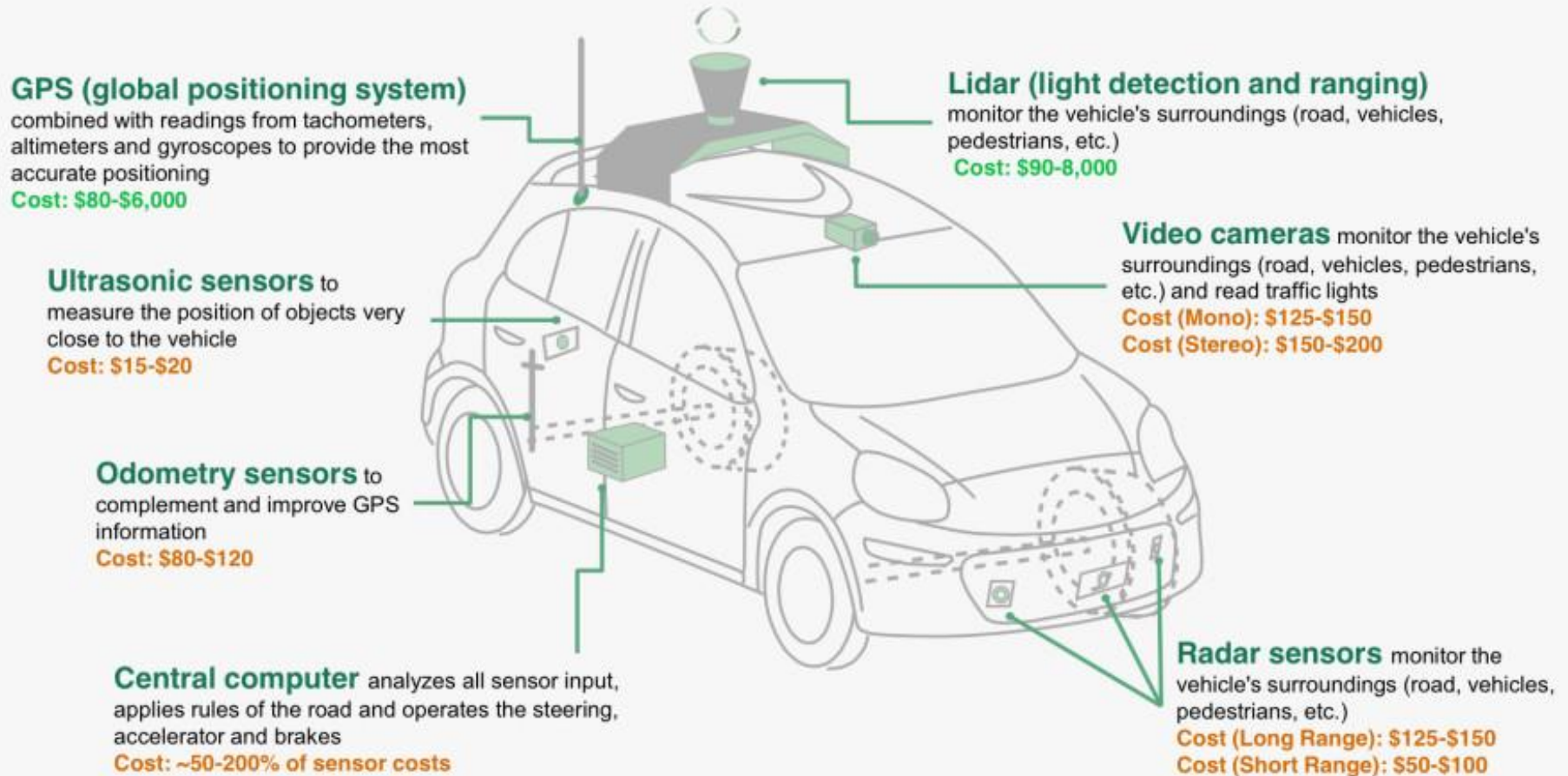
established

emerging

- ✓ adaptive cruise control
- ✓ lane alignment/steering
- ✓ crash avoidance
- ✓ cross traffic assistance
- ✓ parking assistance

cost of control elements:

\$80K now, eventually \$10 - \$15K



autonomous vehicle classification

- level 1 – no automation
- level 2 – function-specific automation
- level 3 – combined function automation
- level 4 – full self-driving automation

2015 – 17 models: level 3

Volvo XC-90 (pilot assist)



Tesla model S sedans (autopilot)



Audi Q7 (adaptive cruise + steering)



Cadillac CT6 sedan (super cruise)



photo credit: Wired Magazine



Wired Magazine hack of 2014 Jeep



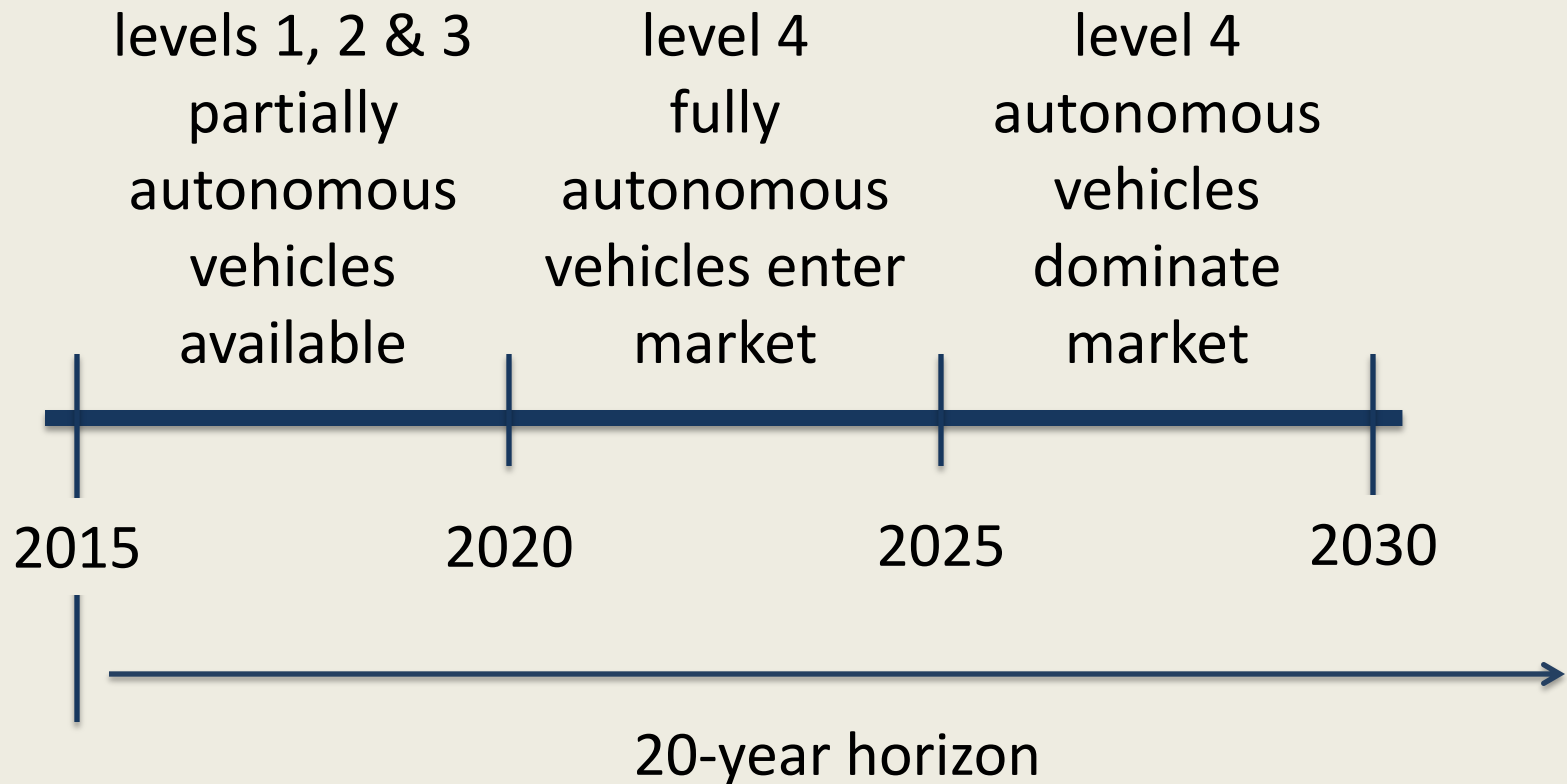
fatal Florida crash – Tesla on autopilot

most difficult challenge: local streets

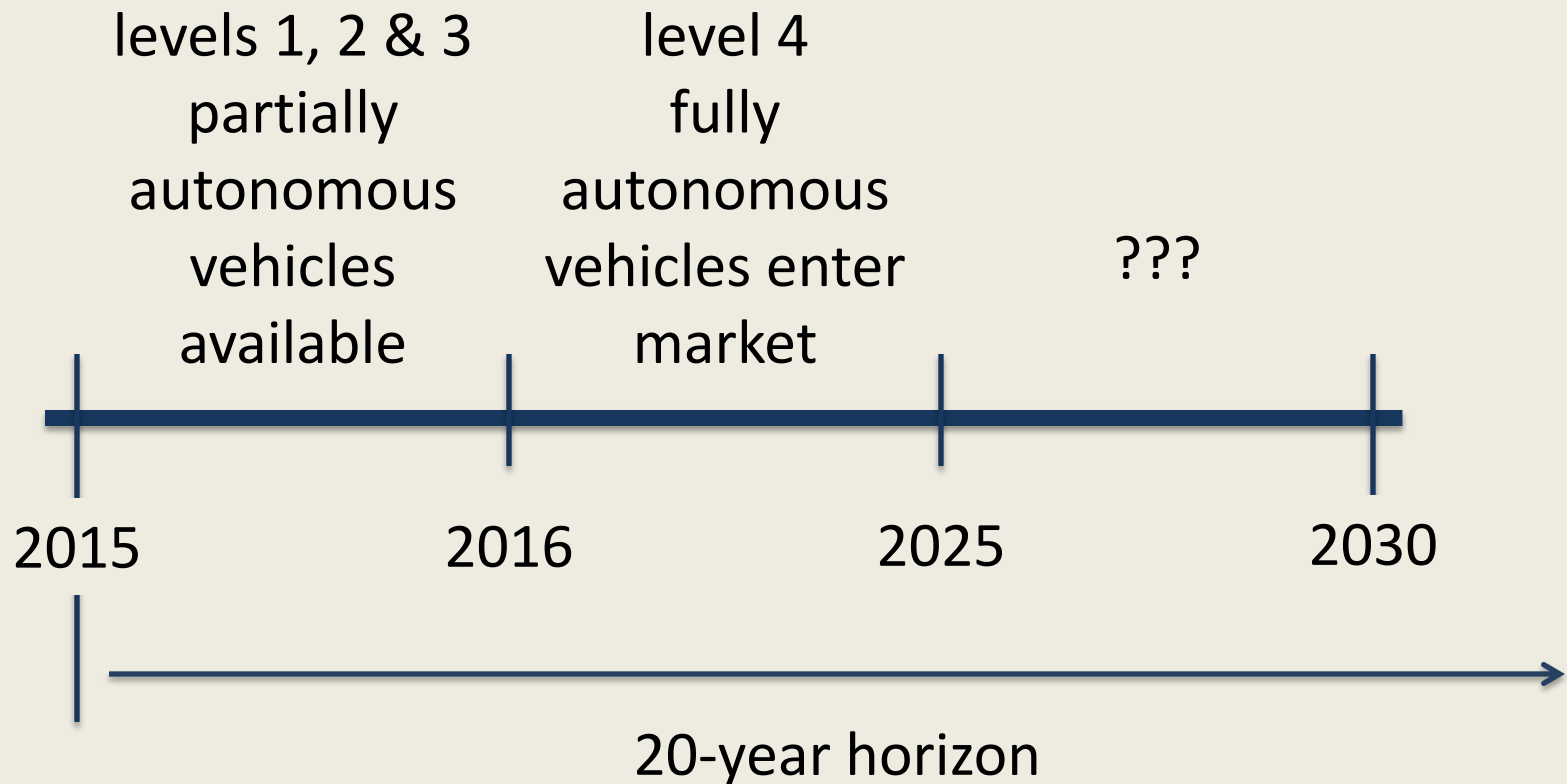


image credit: Thomas J. Bamonte, www.tmemag.com

autonomous vehicles roll-out



autonomous vehicles roll-out



credit: John Zimmer, Lyft

**HUMAN
DRIVERS**



TODAY

**AUTONOMOUS
+ HUMAN**



**5-10
YEARS**

AUTONOMOUS



**10
YEARS**

industry forecast



the sharing economy
the end of ownership?

car share

- car share companies
- peer-to-peer car sharing

paid ridesharing

- taxis
- on-demand ride-hailing services

car share companies

Buffalo CarShare

Car2Go

eGo CarShare

Flexcar

Getaround

JustShareIt

RelayRides

Zipcar

WeCar by Enterprise Rent-A-Car

Uhaul Car Share owned by U-Haul

Avis On Location by Avis



photo credit: Mariordo (Mario Roberto Durán Ortiz)

peer-to-peer car share companies

RelayRides,
Getaround
JustShareIt



photo credit: Getaround

on-demand ride-hailing companies

Uber

Lyft

Sidecar





on-demand ride-hailing +
autonomous vehicles

culture



image credit: millennial marketing



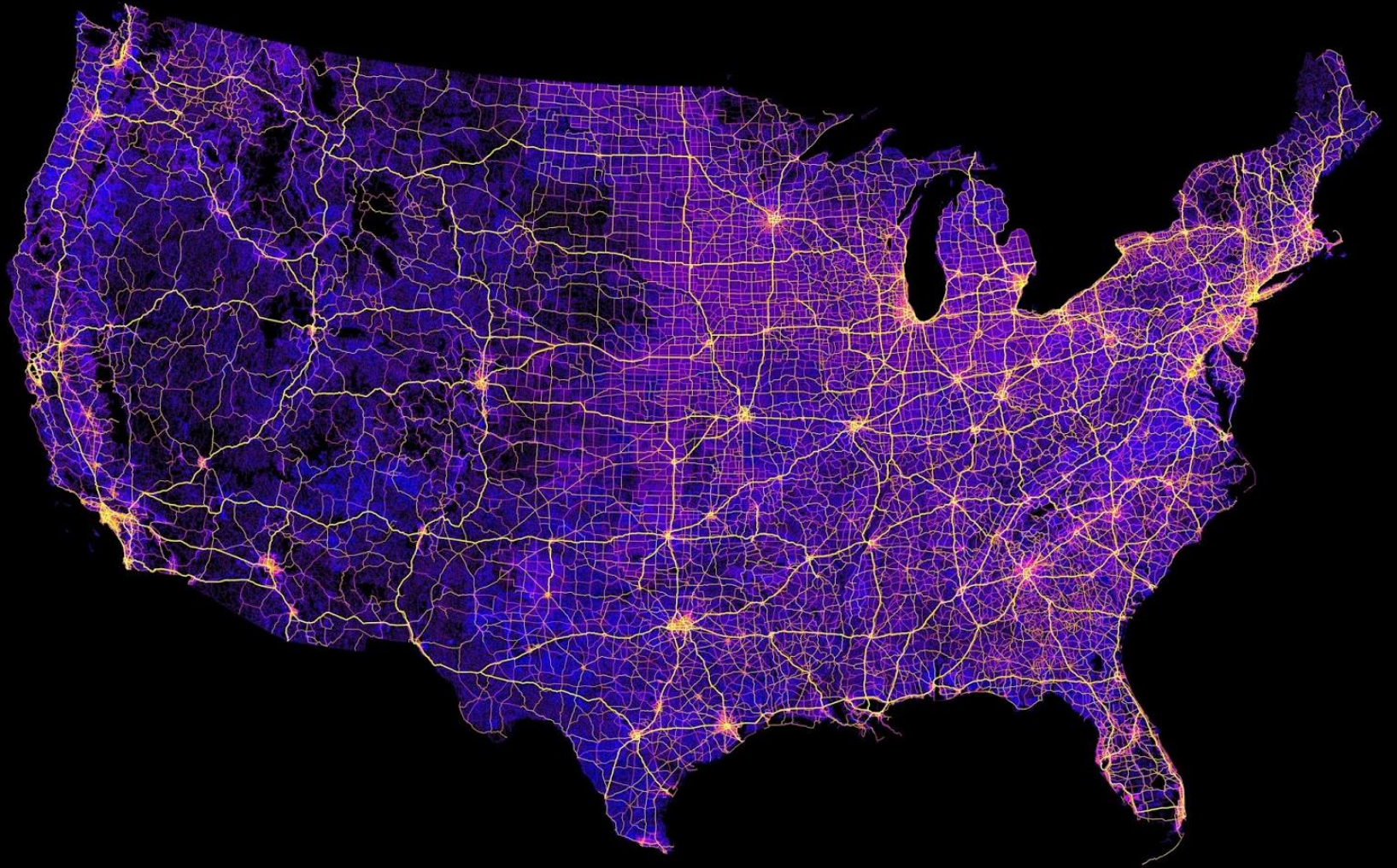
a return to city life



walkable, transit-served, complete neighborhoods



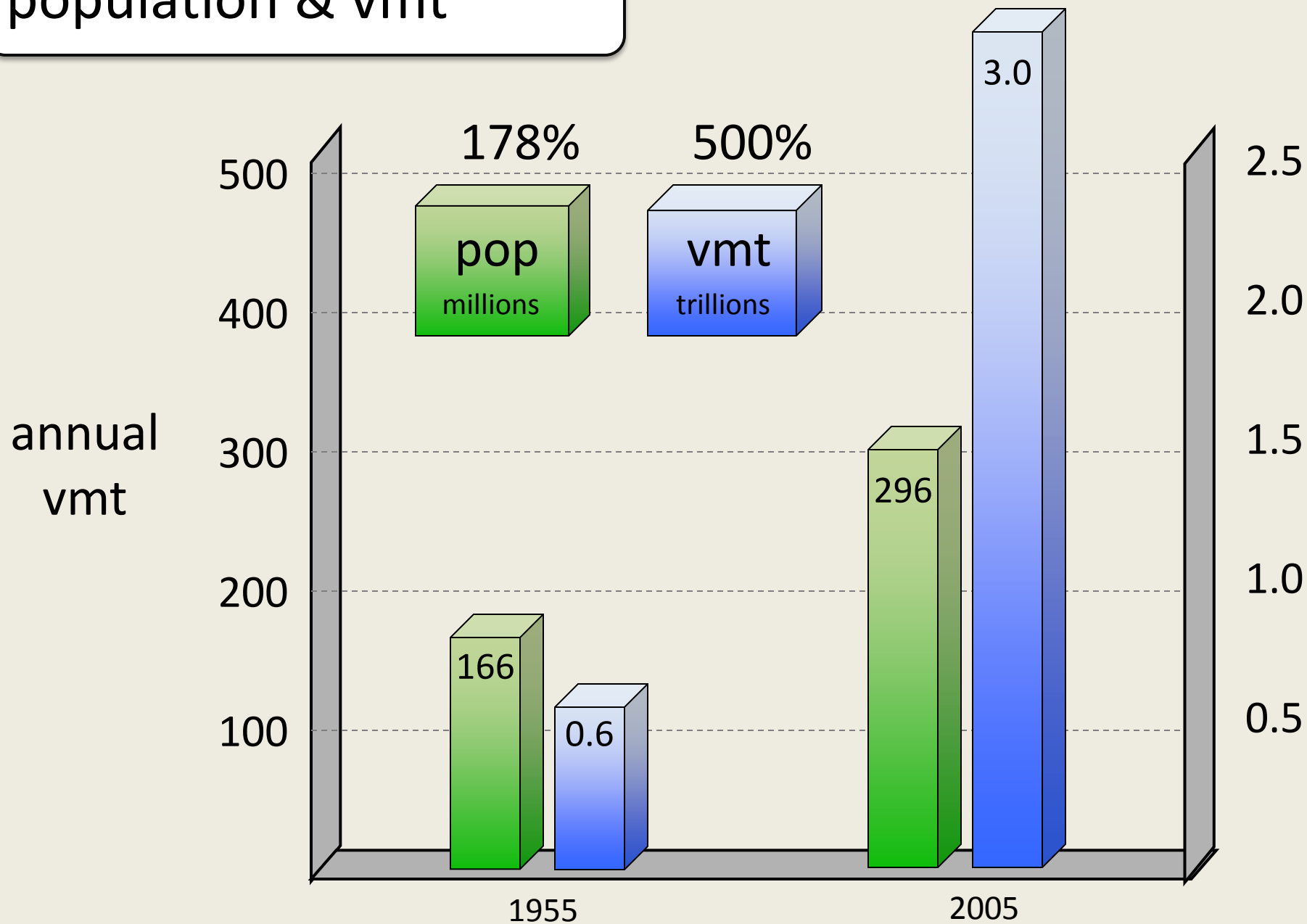
turnaround in driving



EARTHARTAUSTRALIA
www.earthart.com.au/shop/EarthArtAustralia

vehicle miles of travel - VMT

population & vmt



annual US vmt

2000 - 2014

all
vehicles



+ 9.8%

2006 - 2014

all
vehicles



+ 2.0%

US per capita vmt

2000 - 2014

all
vehicles



- 3.8%

2006 - 2014

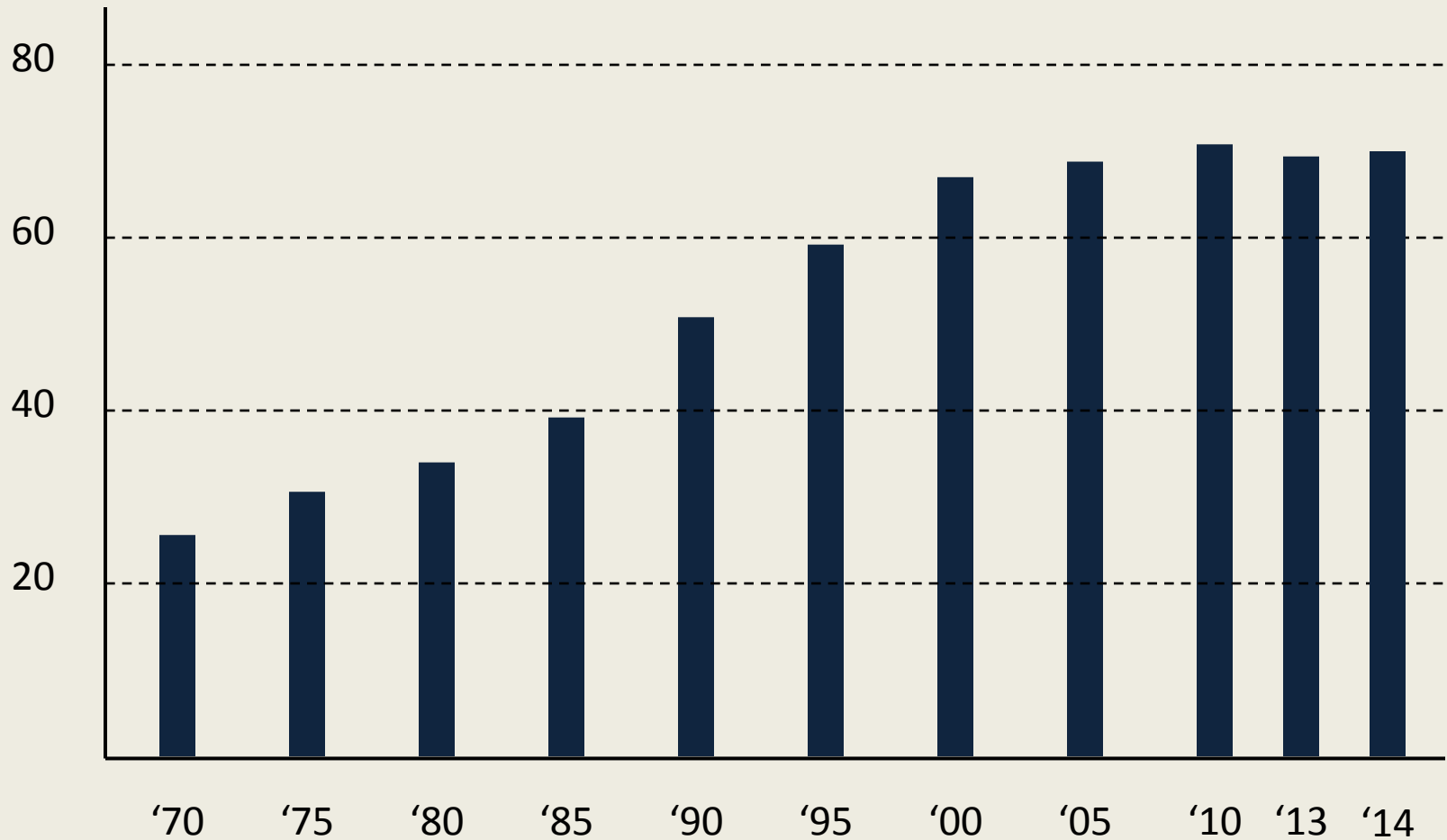
all
vehicles



- 6.2%

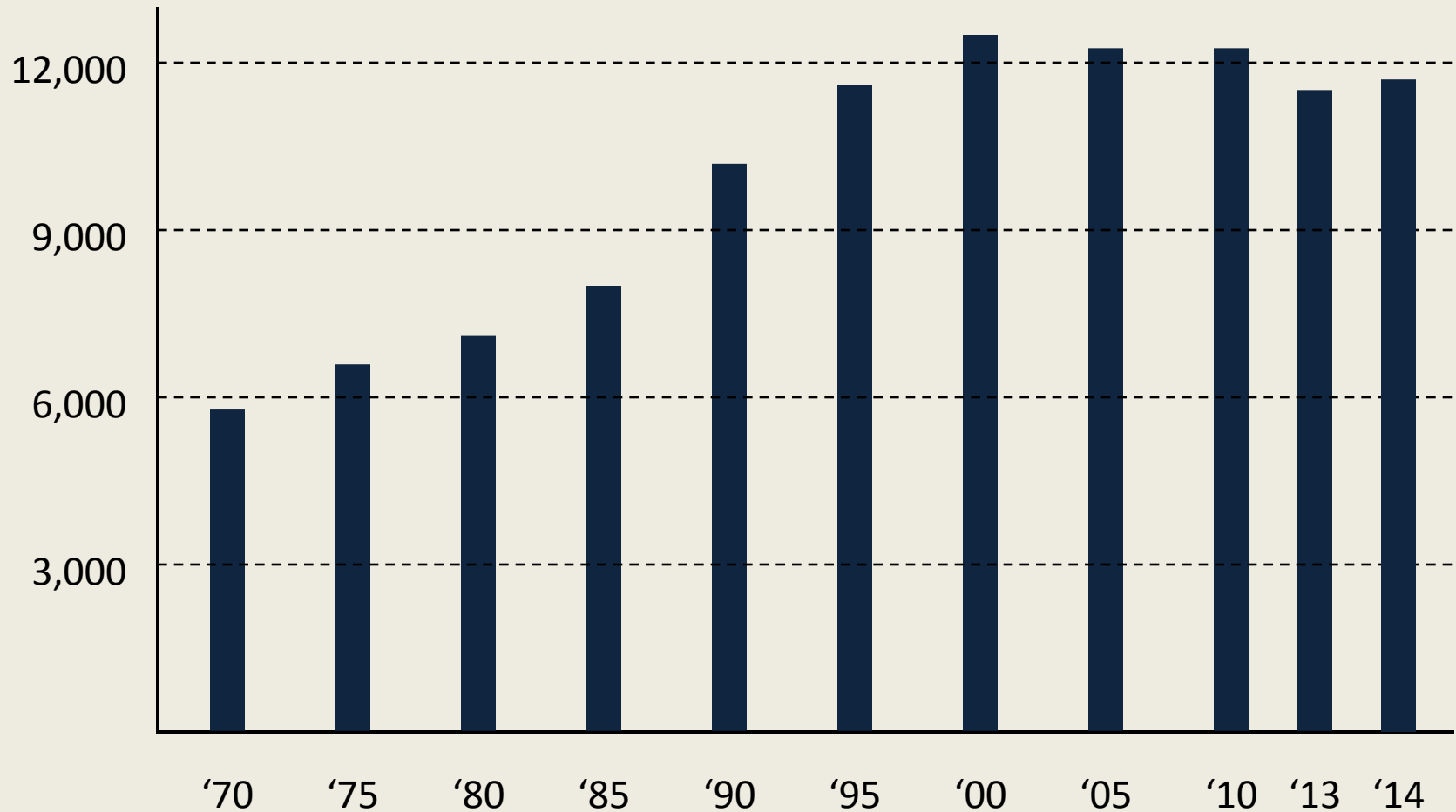
Missouri vmt trend

(billions of miles/year)



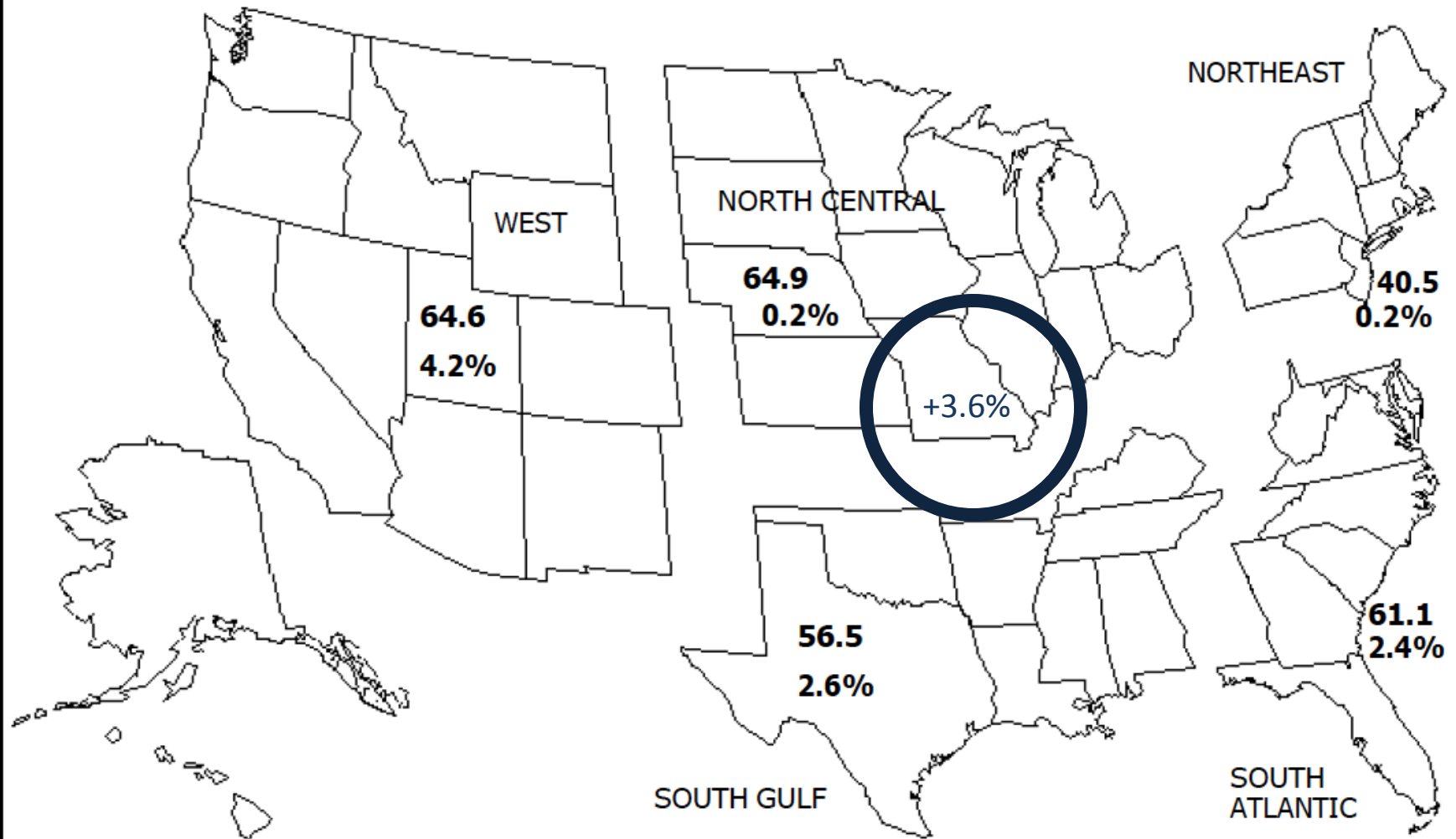
Missouri vmt/capita trend

(miles/year)



Estimated Vehicle-Miles of Travel by Region - July 2016 - (in Billions)

Change in Traffic as compared to same month last year.



20th century trends

demographics & economics

household income



driver license rate



vehicle ownership



population



traffic enablers

expanded roadways



energy subsidy



road subsidy



development patterns



21st century trends

demographics & economics

household income



driver license rate



vehicle ownership



population



traffic enablers

expanded roadways



energy subsidy



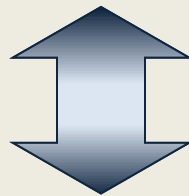
road subsidy



development patterns



parking demand

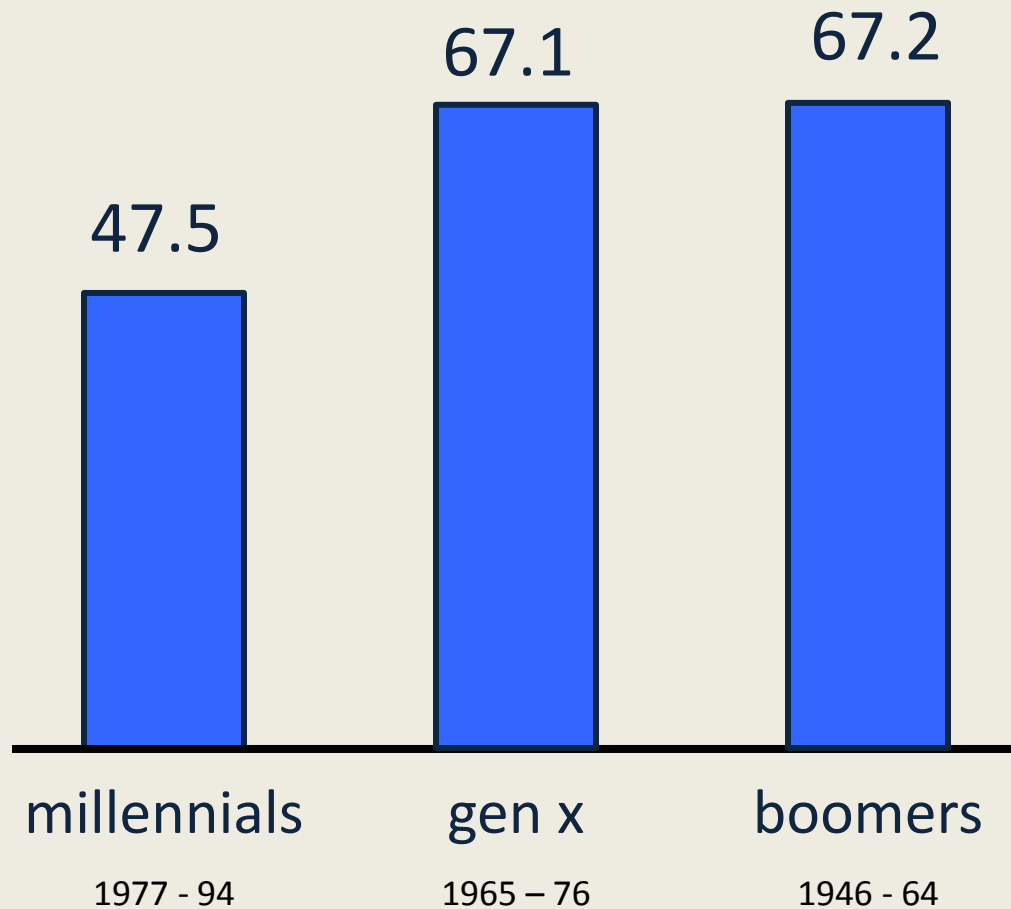


vehicular travel

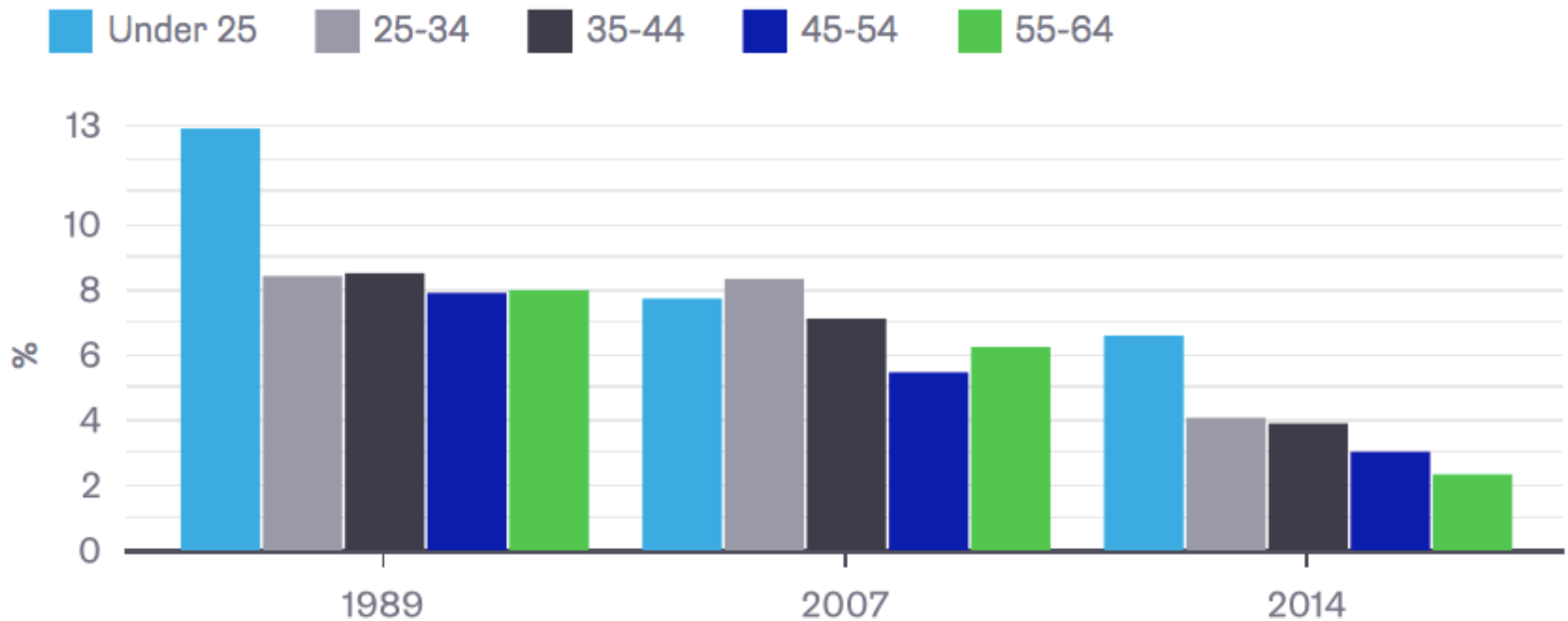


car buying

(US 2014 vehicles purchased/1,000 people)



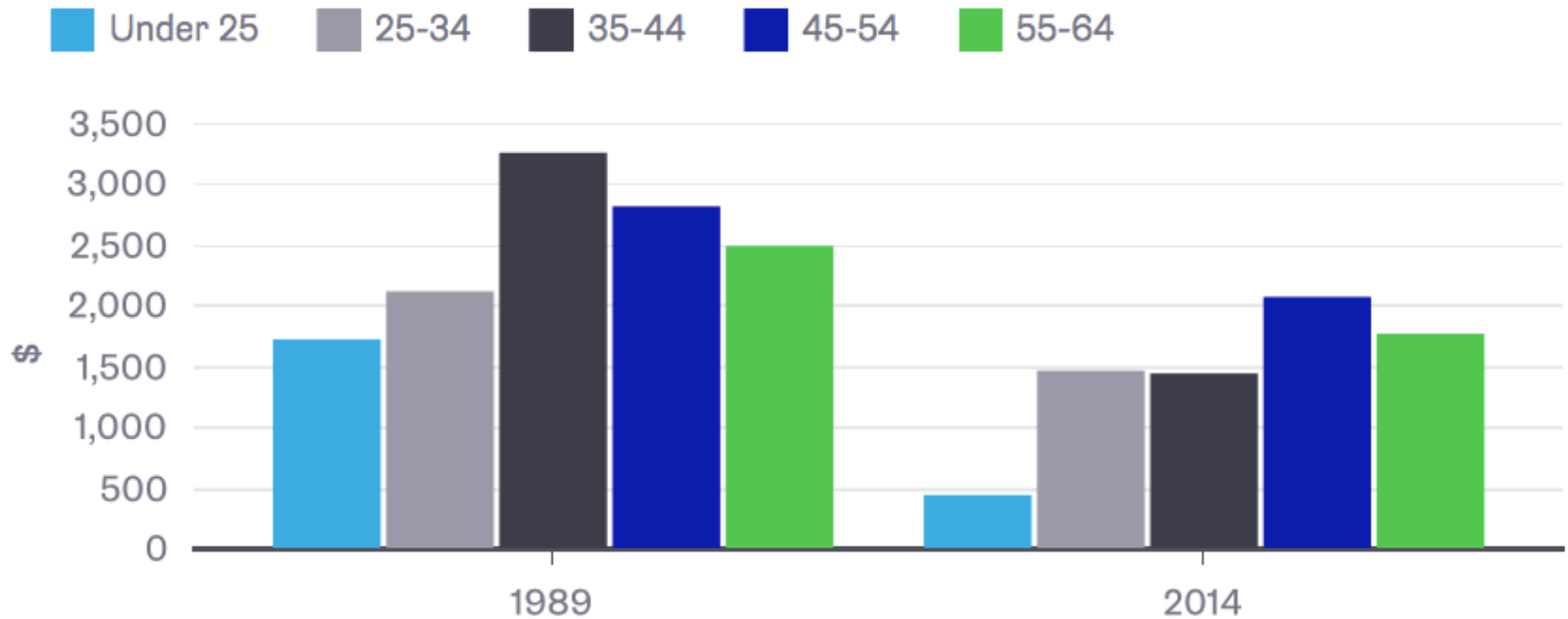
Vehicle buying as a share of total consumer expenditure by age group



Source: Consumer Expenditure Survey

we are spending less on cars

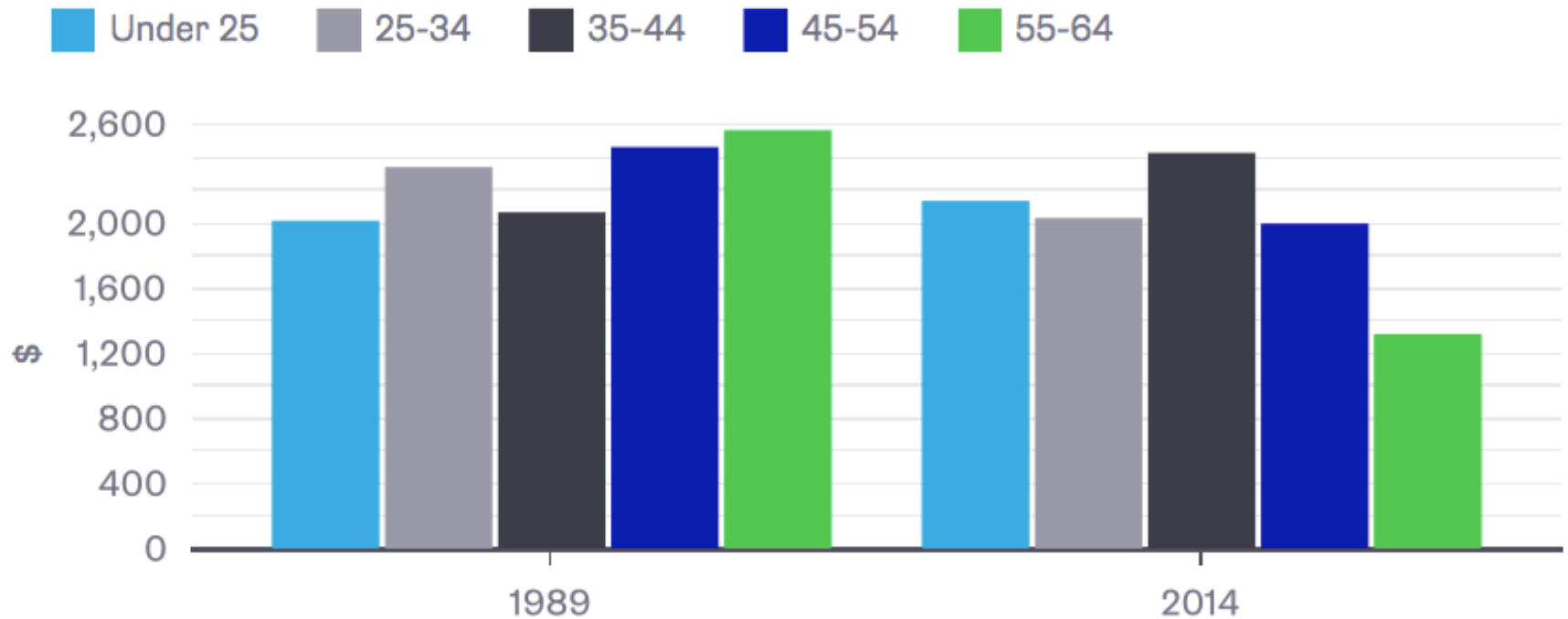
Average spending on new car purchases per consumer unit in 2014 dollars



Source: Consumer Expenditure Survey, author's calculations

much less on new cars

Average spending on used vehicles per consumer unit in 2014 dollars

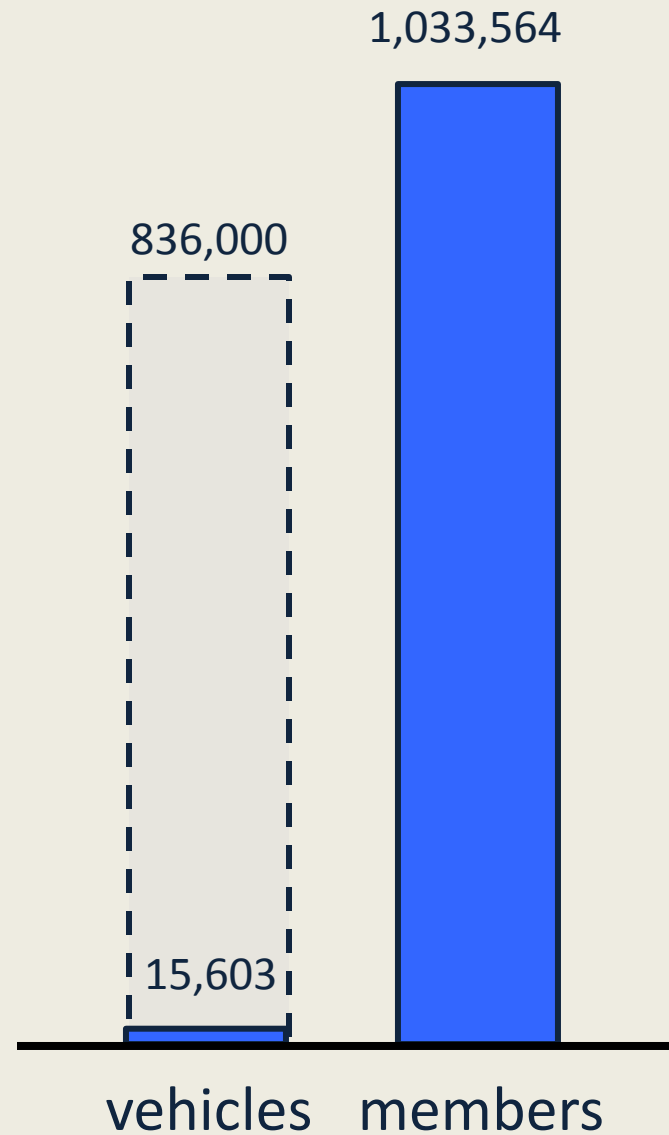


Source: Consumer Expenditure Survey, author's calculations

and less on used cars

car share arithmetic

(US Jan 1, 2013)

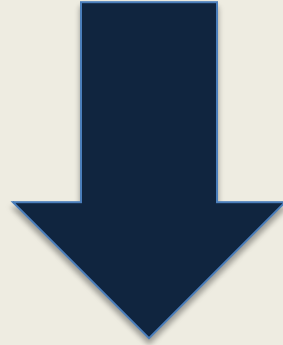




vmt



per capita
vmt



auto
ownership



parking
demand

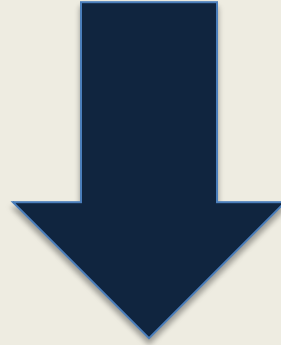
summary – national trends



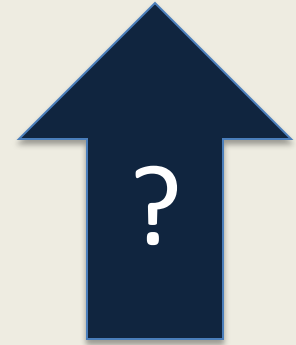
vmt



per capita
vmt



auto
ownership



parking
demand

river market trends

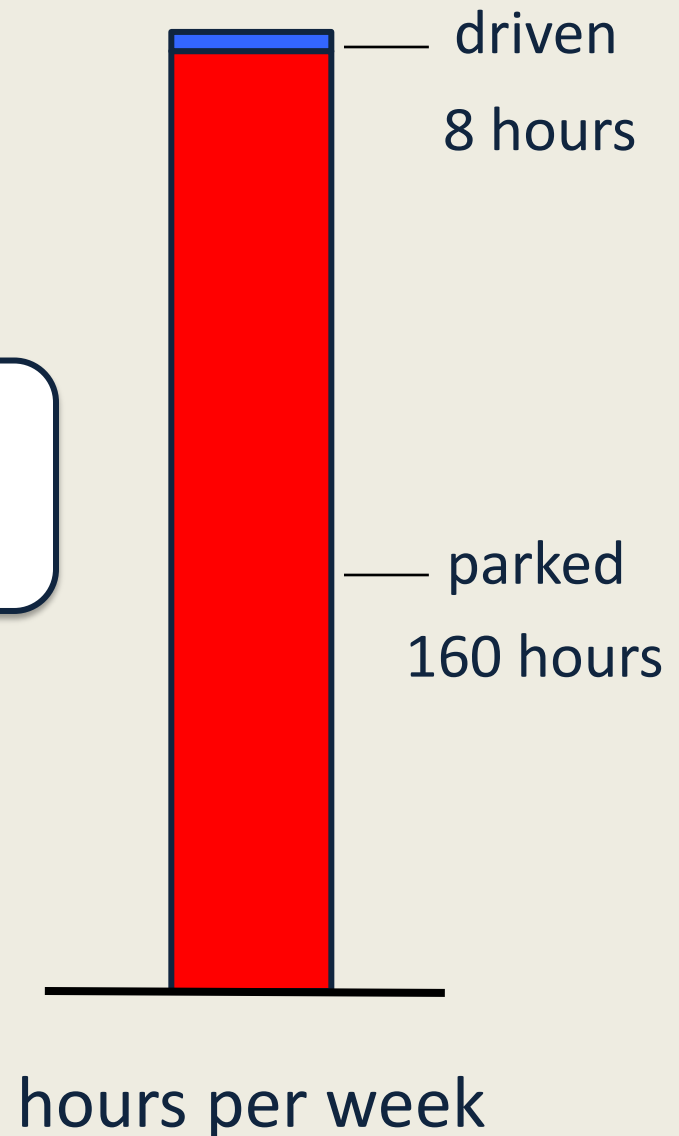


challenges



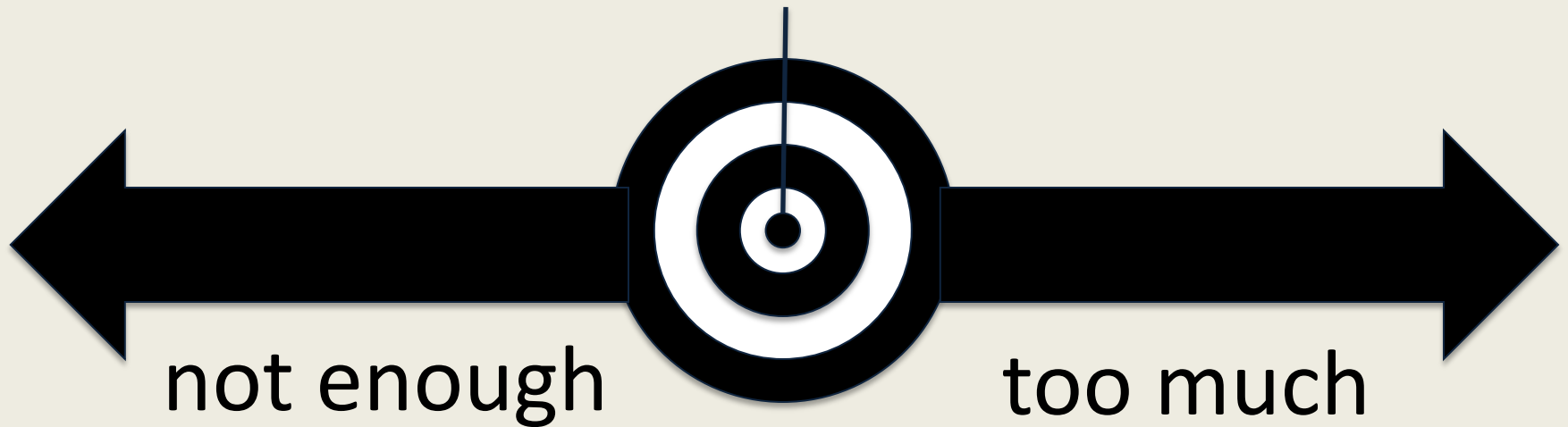
the supply dilemma

personal vehicles in the US
are parked 95% of the time

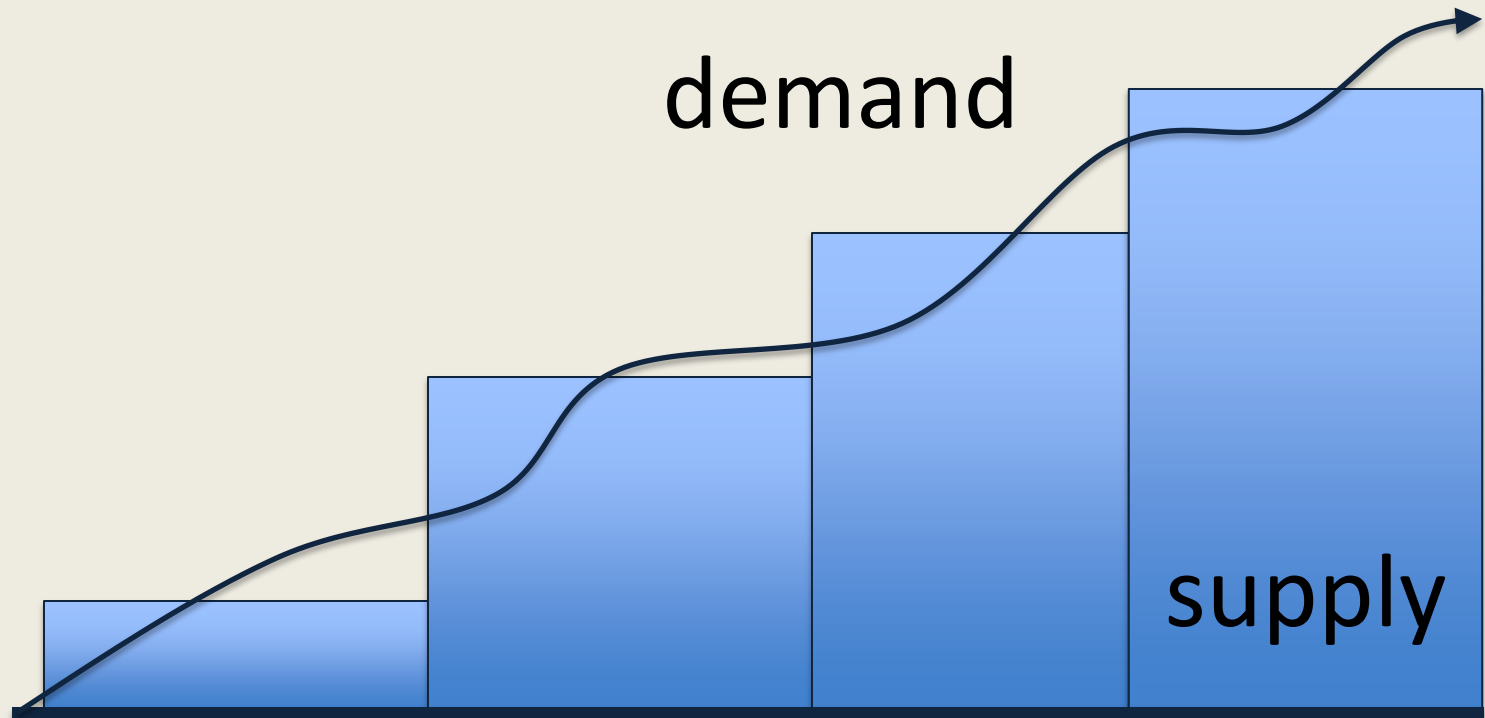


the supply dilemma

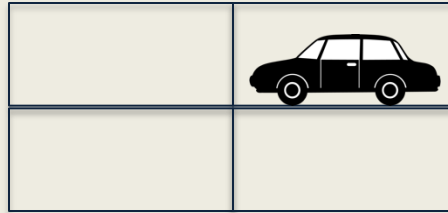
the right
amount



the supply dilemma

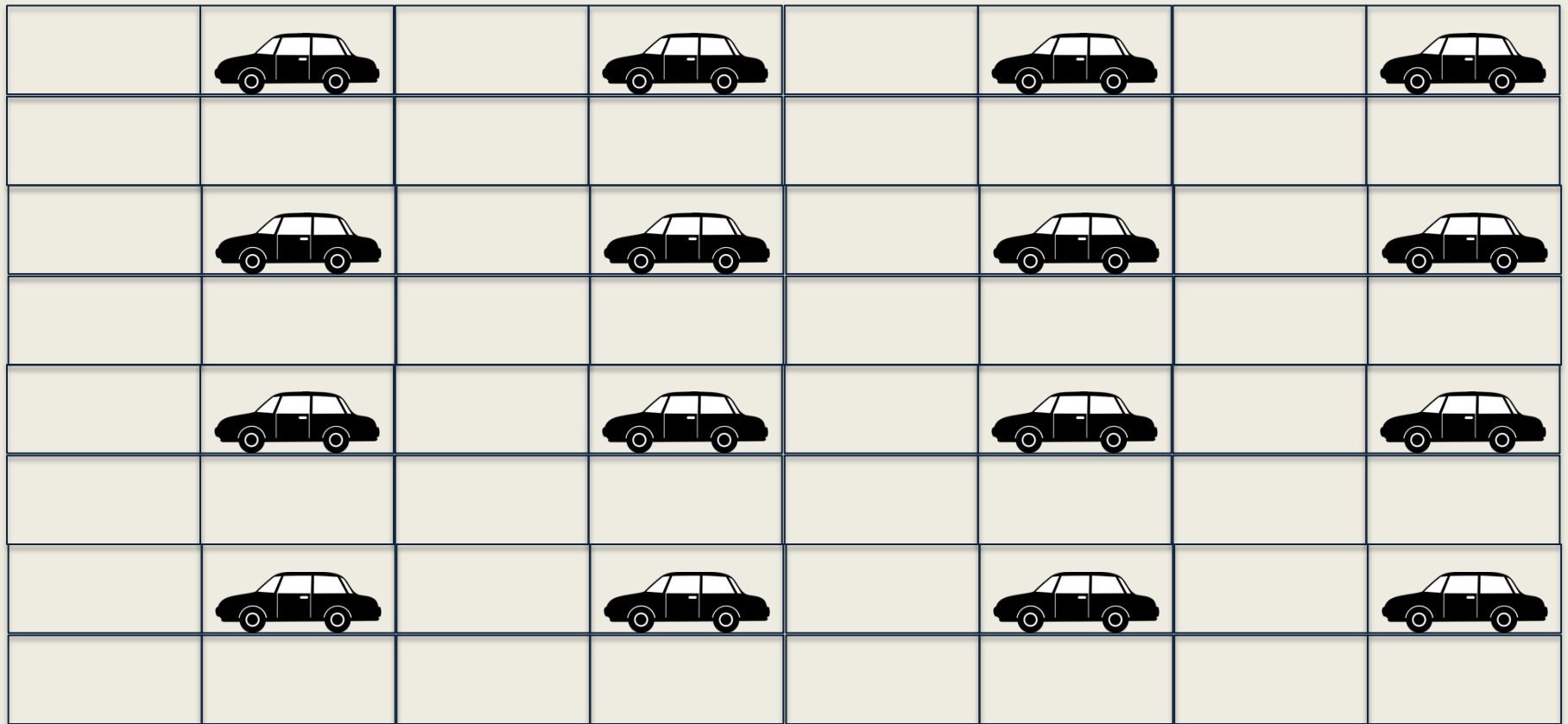


the supply dilemma



















4 spaces / car

the supply dilemma



















4 spaces/car

10:00 AM

4 spaces/car

10:00 PM

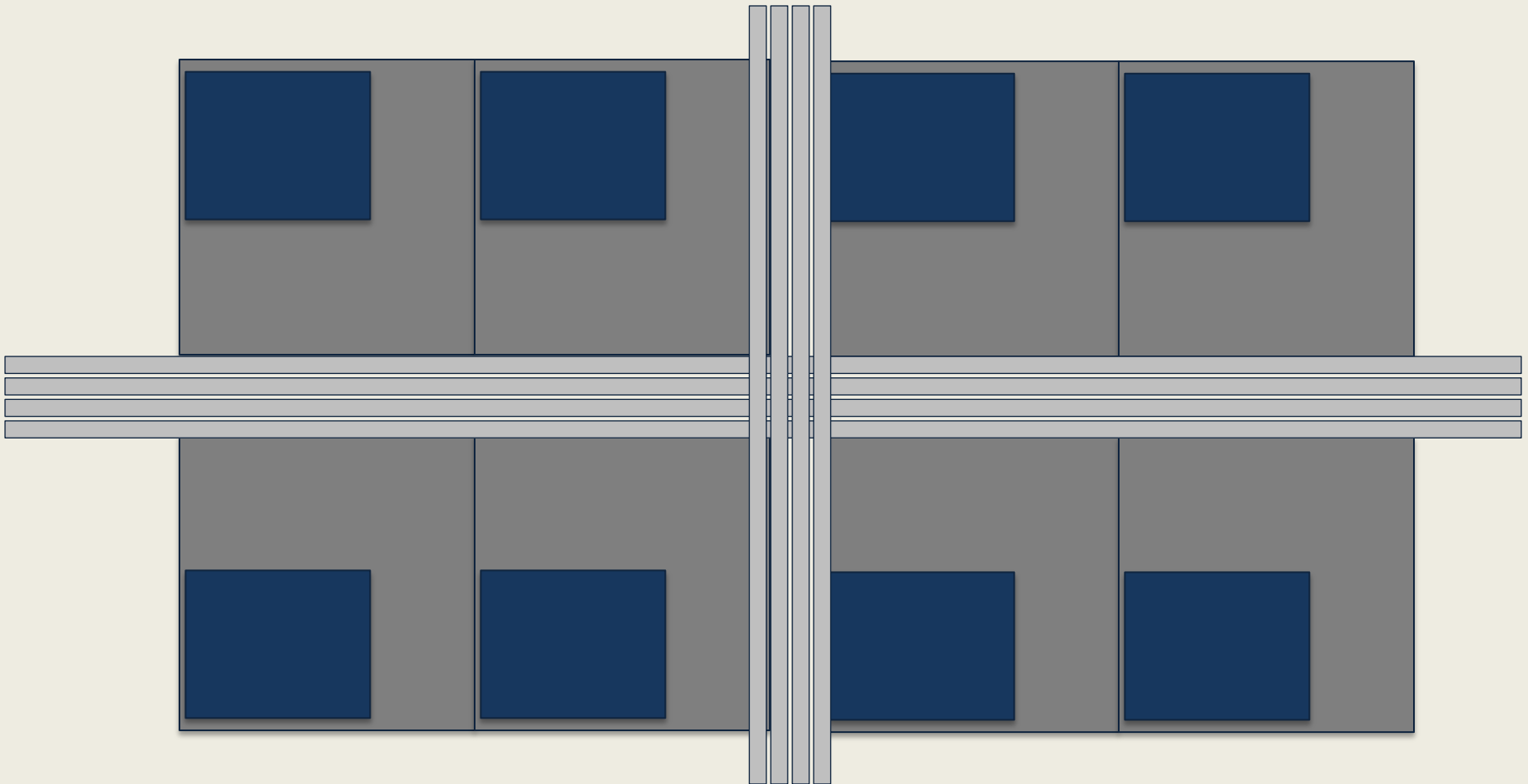
land economics



@ 6 spaces/1,000sf,
parking area = 2 X building area

land economics

‘why there is
no there there’





design matters

suburban



design matters

urban



design matters



no such thing as free parking

- ✓ land cost
- ✓ capital cost
- ✓ operations & maintenance

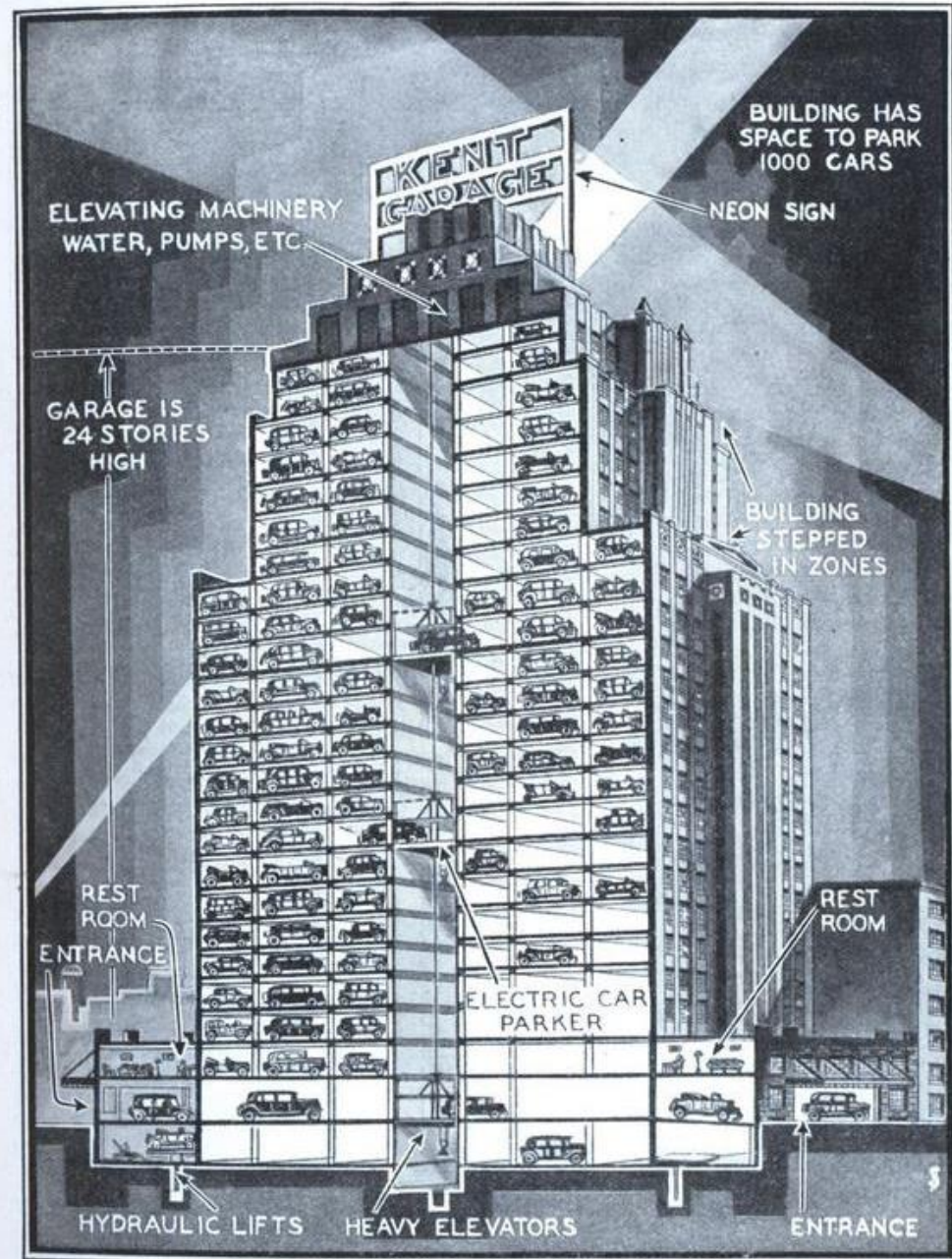




parking management



“give me control of parking and I will rule the world!”





on-site parking: a suburban concept



downtown utilities

water

solid waste

sidewalks

storm sewer

sanitary sewer

parking



parking as a utility

- ✓ shared resources
- ✓ reduced costs
- ✓ fair-share funding
- ✓ management and operations

“park once”



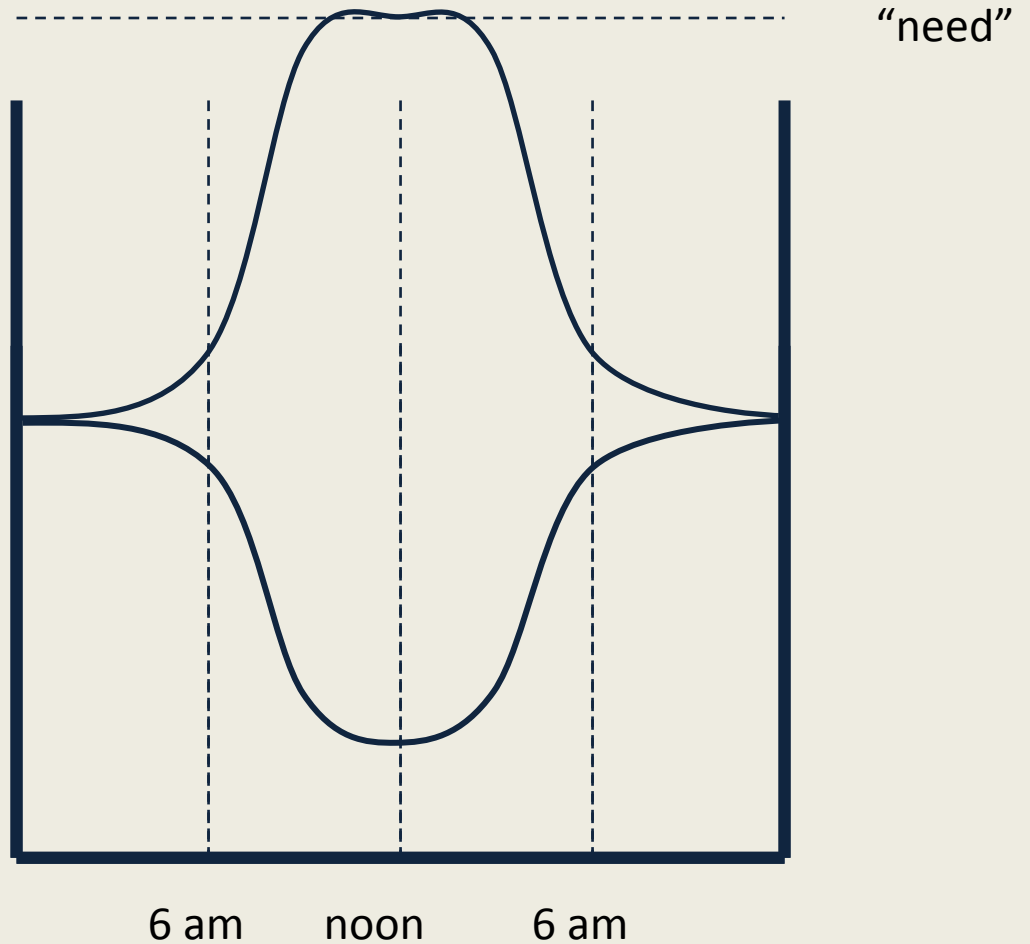
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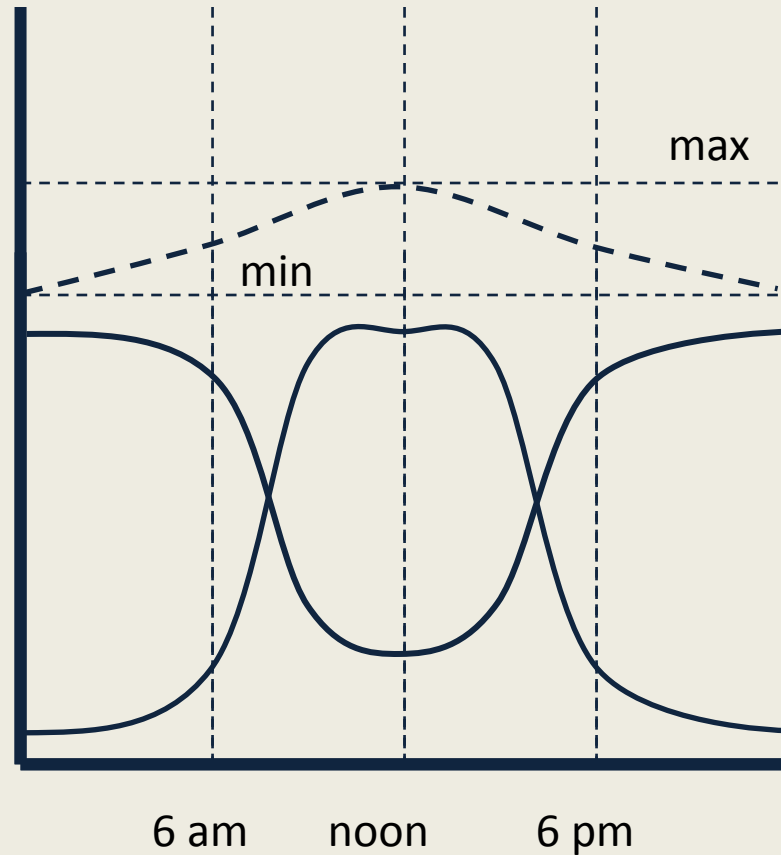
traditional

residential + office



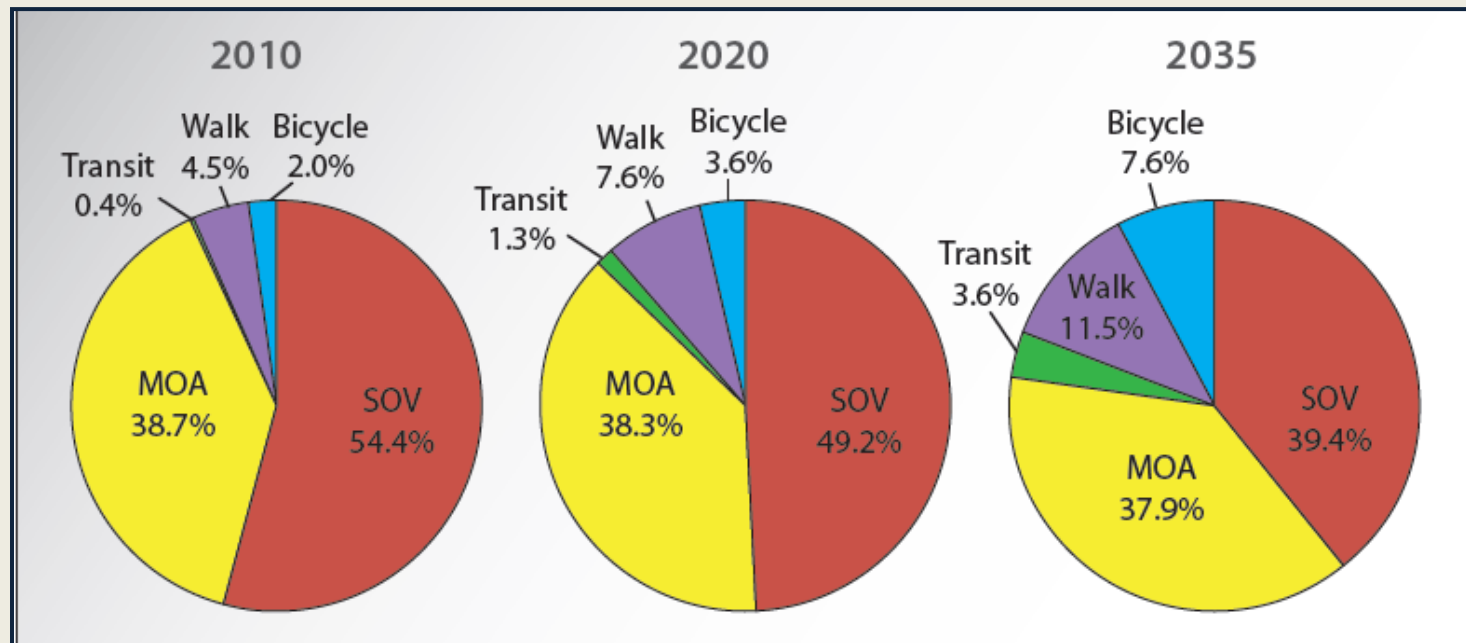
shared parking

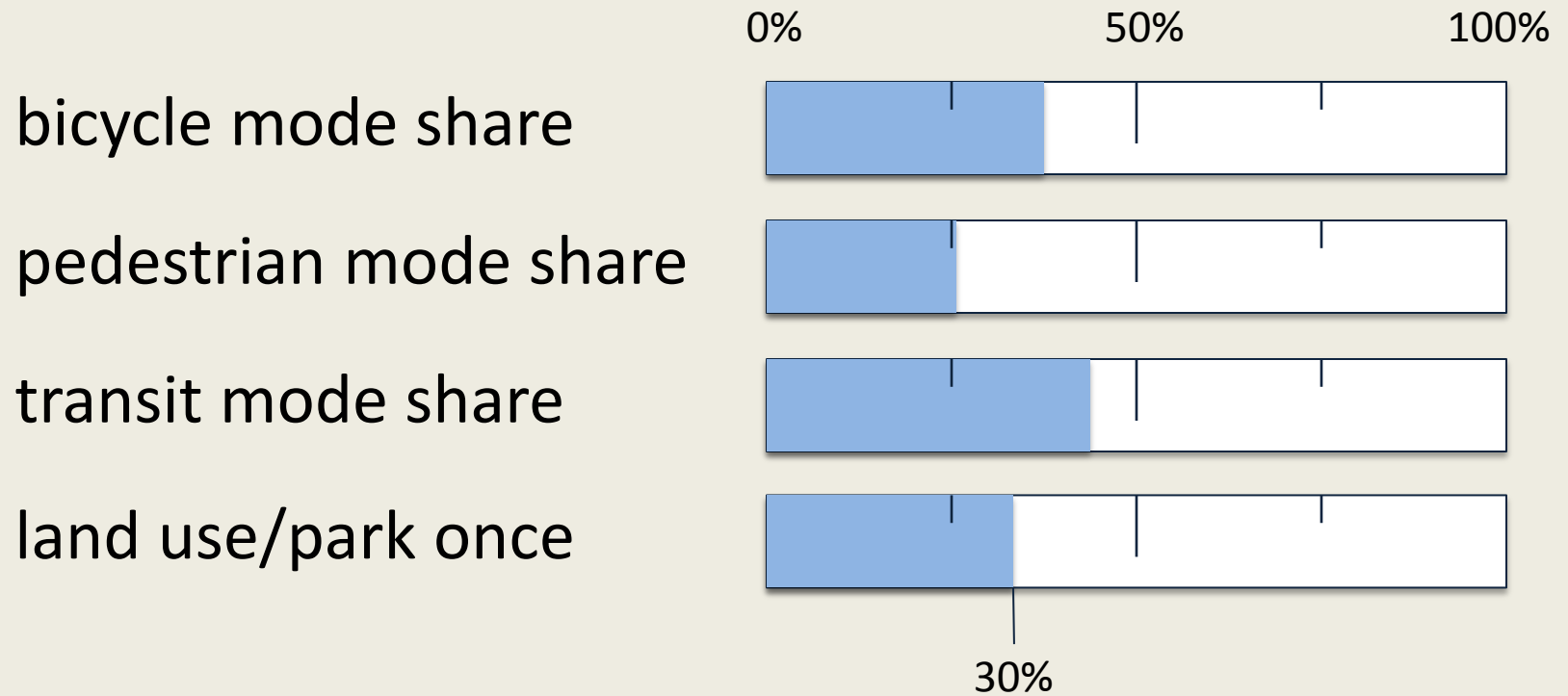
residential + office



mode share

- ✓ expensive
- ✓ technological
- ✓ other benefits





combined total reduction in demand: > 50%

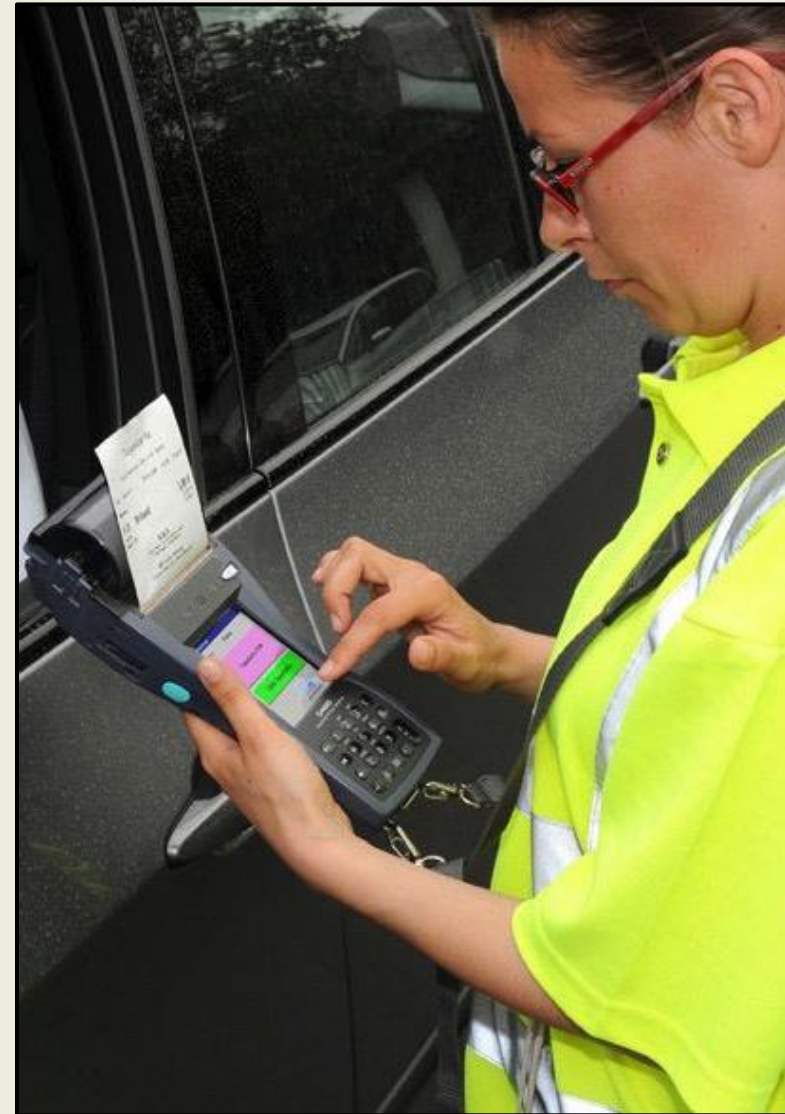
reasonable mode share ranges
(trip mode share)

enforcement



enforcement

- ✓ friendly but inevitable
- ✓ rely on technology

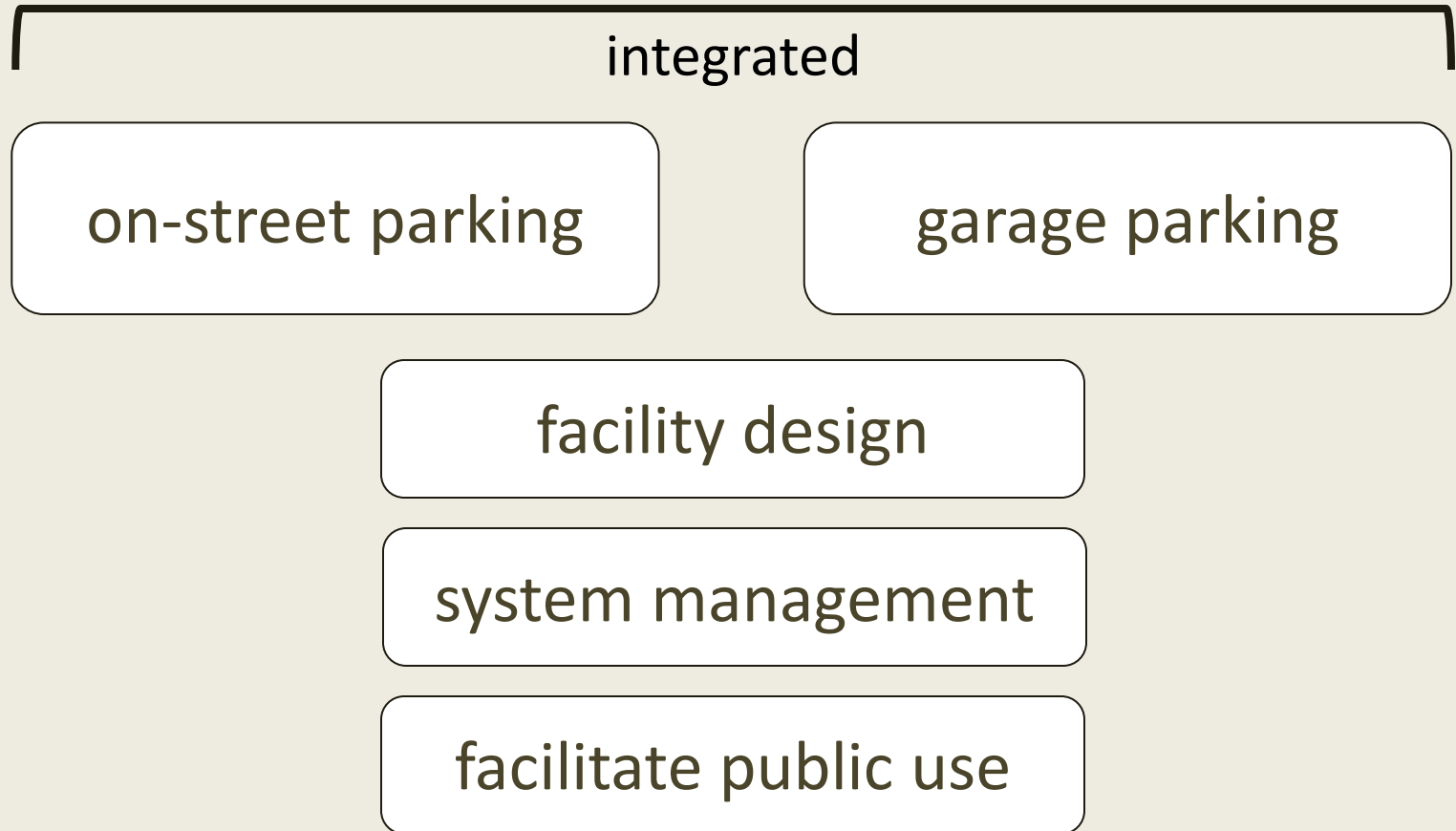


pricing

- ✓ eventually necessary
- ✓ technology benefits



smart parking technology options



wireless mesh network

vehicle sensors



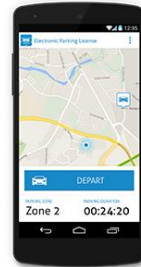
relay node



data collector



displays



smartphone apps



server + software +
internet connection

integrated approach

land use

land use inventory

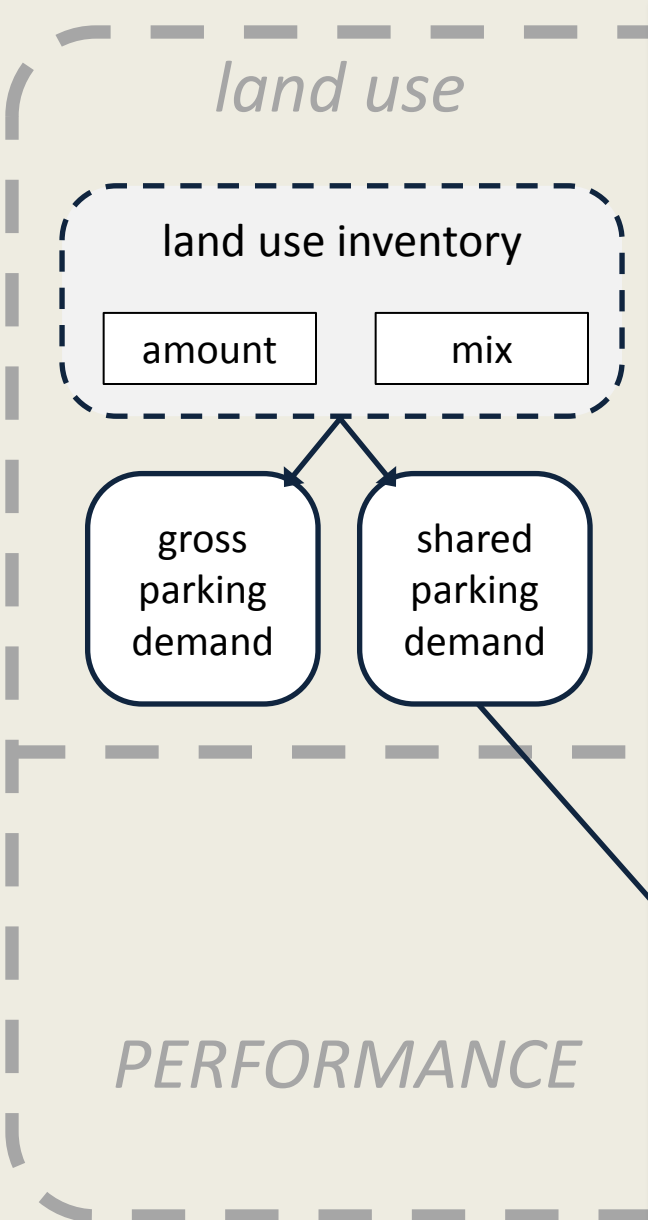
amount

mix

gross
parking
demand

shared
parking
demand

PERFORMANCE



integrated approach

land use

parking management

land use inventory

amount

mix

gross
parking
demand

shared
parking
demand

management program

add parking supply

shift mode share

parking pricing

enforcement

PERFORMANCE

net demand

\$ cost

peak
ratio
85%

integrated approach

land use

parking management

supply

land use inventory

amount

mix

gross
parking
demand

shared
parking
demand

management program

add parking supply

shift mode share

parking pricing

enforcement

base parking
supply

new parking
supply

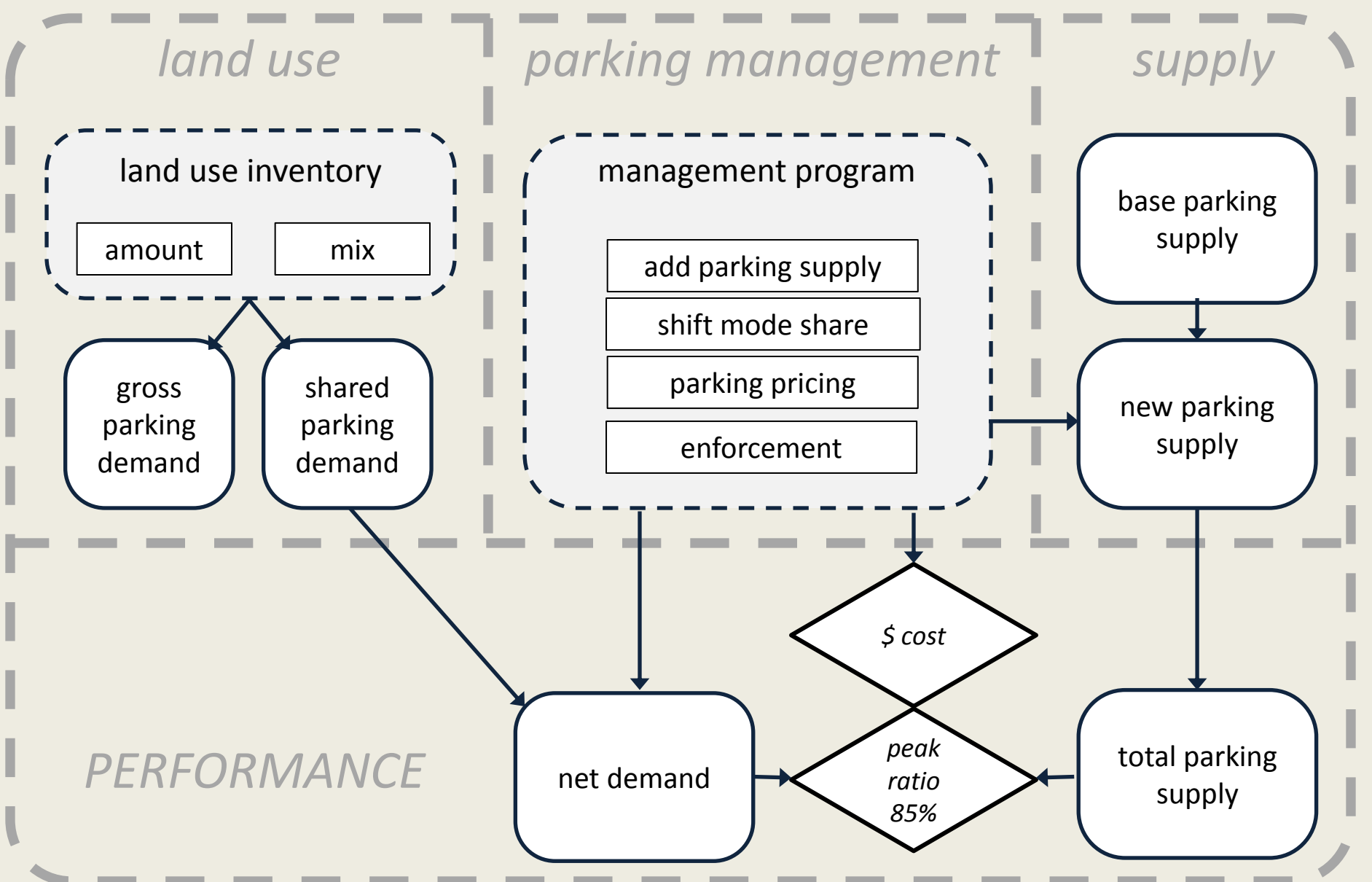
PERFORMANCE

net demand

\$ cost

peak
ratio
85%

total parking
supply





wrap up





cost to build & maintain



benefits of good access



land opportunity cost

balanced, strategic approach



discussion

